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PEASANT COOPERATION FOR WATERSHED MANAGEMENT IN MAISSADE, HAITI: FACTORS ASSOCIATED WITH PARTICIPATION

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ABSTRACT

Soil erosion is an important contributor to the agricultural decline, poverty, and emigration which characterize rural Haiti today. The numerous soil conservation projects have often ignored indigenous knowledge, techniques and socio-cultural institutions and have not generally resulted in sustained conservation. Limited adoption rates have supported widespread

assumptions that peasants were noncooperative, individualistic actors who required substantial external incentives for changing land use behavior. An alternate strategy was utilized in Maissade, Haiti, where peasants now cooperate to treat small, multiple-owner watersheds. Field research was conducted to understand the cooperative action and the socio-economic factors associated with participation ("e.g." cooperation) and defection.

Study results indicate that approximately one-half of watershed landholders participate, and a majority of labor is contributed by persons who do not own land in the watersheds. Participants also regularly treat nonparticipant land, and land tenure status is independent of both landholder participation and structure placement. Indicators of landholder exposure to trans-boundary erosion and the potential to economically benefit are associated with participation while the realization of a direct benefit is not. Landholder wealth status is independent of participation though landholders are significantly more wealthy than non-watershed participants. Participation is also strongly associated with membership in farmer cooperatives and labor exchange groups, and the previous adoption soil conservation innovations. The findings challenge conventional wisdom concerning peasant behavior in Haiti and also suggest that support of indigenous cooperative institutions can facilitate the treatment of common environmental problems.

PREFACE

The author is currently conducting research on local institutions, land use, and policy issues in Haiti. Field research for the material presented in this report was conducted during the months of August, September and December of 1990 in Maissade, Haiti. The author is grateful for Save the Children Federation support during the field survey period and for staff participation in the development of the research methods and data collection. The advice and support of the University of Minnesota Forestry for Sustainable Development Program and the Inter-American Foundation is also greatly appreciated. Special thanks are especially due the peasants of Maissade whose eagerness to participate in the study made it a pleasure to conduct.

A draft of this report was originally prepared in November of 1990 for the SCF field staff who were in the process of evaluating their micro-watershed program. That report contained specific SCF program comments and recommendations. This updated report briefly describes the pilot program, research objectives, methods, and preliminary findings. The author would appreciate comments and criticisms from readers.

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INTRODUCTION

Watershed Management Experience In Haiti

Numerous rural development, reforestation, soil conservation and agriculture development projects have been implemented in Haiti. By most accounts, the majority have been unsuccessful in achieving significant and lasting impacts (AID 1990, BREDA 1988, Bureau 1986, Murray 1979). Watershed management projects (including reforestation and soil conservation projects) in Haiti have predominantly utilized the "equipment du territoire" approach to environmental rehabilitation. This approach has been generally characterized by large-scale prescriptions for contiguous land treatments, large ravine treatments, mechanical rather than biologic structures, and monetary and commodity incentives to attract peasant participation (Lilin and Koohafkan 1987). Highly degraded and steep lands have often been primary targets for intervention.

The use of this approach for the treatment of privately held lands - the vast majority of upland watershed lands are privately owned -- has been criticized by many development professionals for failing to result in the sustained adoption and maintenance of the techniques promoted (Lilin 1986, Pierce 1988). Basic weaknesses include a primary orientation to the protection of downstream investments rather than on-site benefits; a disregard

on individual landholder prerogatives, indigenous knowledge or techniques, socio-cultural institutions or land tenure complexities (Murray 1979 and Lilin 1986). In addition, professionals have claimed that the provision of commodity or financial incentives can be demeaning, reduce self-reliance, depress local crop prices, and cause farmers in adjacent areas to suspend adopting techniques voluntarily.

An "agricultural parcel" approach to watershed management developed in the early 1980s to complement and serve as an alternative to the "equipment du territoire" approach (Smolikowski 1989). Inherent in the new approach was the recognition that:

1) farmer remuneration was not necessary for technique adoption and even acted against technique maintenance and diffusion;

2) a number of low input, indigenous, anti-erosion techniques existed which could be improved, and;

3) peasants have a natural incentive to conserve soil in order to increase agricultural production.

This new approach has proven widely successful as numerous farmers have voluntarily adopted and maintained soil conservation measures. The approach embodies a farmer rather than an engineering perspective of soil erosion, and views watersheds as primarily a set of agricultural parcels rather than as one contiguous physical unit. Projects which use the "agricultural parcel" approach generally employ classic agricultural development strategies: training and hiring field extension agents; integrating basic agricultural themes into resource conservation dominated extension programs; and conducting basic, adaptive agricultural research. Such projects also tend to include or be associated with programs in community development or public health and have often carried the title of "integrated" watershed management projects.

Recommendations for a Landholder Cooperation Approach to Watershed Management

The "agricultural parcel" approach has proven effective in achieving the treatment of individual and private parcels and is a widely utilized project approach in Haiti. Use of this approach alone though does not resolve the problem of erosion which crosses private property boundaries, occurs between two private boundaries, or in public domain courses. This problem of "trans-boundary" erosion multiplies with growing land subdivision as natural boundaries, ridges and gullies, are increasingly used to delineate boundaries. Unless such erosion is treated, the "agricultural parcel" approach does not result in improved overall levels of agricultural production and environmental rehabilitation which is the goal of watershed management in Haiti.

In these circumstances, there is a need for watershed management approaches which build on the success of the "agricultural

parcel" approach yet explicitly target "trans-boundary" erosion.

In Haiti, where parcels are small and erosivity high, such an approach should address the close interdependence of land productivity -- how upstream land use affects downstream productivity, and how both upstream and downstream landholders are better off if erosion is reduced. Such an approach must then promote either landholder land use agreements and independent landholder action, or collective agreements and collective action to install soil conservation treatments. Whatever the choice, both modes require landholder cooperation, and call for new extension themes, different program strategies and perhaps new social formations.

Many authors and development workers have cited the need to recognize and empower local, indigenous groups in natural resource projects. Several authors, notably Dani and Campbell (1986) and Bochet (1986) have explicitly and thoroughly treated the subject of local participation in watershed management activities. Few authors have specifically proposed the promotion of collective landholder action for treating watershed lands which are common to them.

Cernea (1989) has called for watershed management approaches which form "watershed groups" (groups of farmers based on land ownership within watersheds) to establish and maintain watershed and forestry treatments. In a similar vein, Murray (1990) has promoted the establishment of "hillside units" of Haitian farmers to collaborate on the treatment of contiguous watershed lands. Uphoff (1986) also recommends the recognition and promotion of local groups for watershed management. McKean (1986) states that the though limited, the literature from Japan shows that collective management is capable of assuring stable and productive use of watersheds over a long period of time. None of the above authors has explicitly proposed methods to form such groups, or discussed requisite incentive structures for farmer participation.

Gibbs (1986) also concluded that watershed projects should adapt their methods to reflect customary institutional arrangements, and create incentives for local groups to participate in watershed management activities. Rocheleau and van den Hoek (1984) described a project where landholders of a small watershed were encouraged to cooperate on the installation of agroforestry treatments for watershed management. No follow-up reports which indicate the effectiveness of the project or sustainability of the activity are publicly available. Perhaps the most concise and explicit call for research into landholder cooperation for watershed management is found in Brooks et al. (1990):

"What is needed is basic research to identify possible mechanisms to promote cooperation among watershed residents and users, and the development of practical systematic methods for identifying possible mechanisms on a case by case ("i.e.", project) level. In this context it would be appropriate to look at both traditional and current patterns of political and social organization, particularly labor exchange, among the various groups concerned, patterns of interaction among those groups and between them and government officials, and the relative success (or lack of it) of previous attempts to promote cooperation

within watershed areas."

The Problem: Understanding Factors Associated With Participation in Cooperative Watershed Management

In sum, there is consensus for the need of an expanded role of local, cooperative institutions in watershed management, but theories concerning such institutions, how they might be identified, evolve or be promoted are limited. Before formulating theories concerning the emergence of cooperative institutions for watershed management, and before evaluating the watershed management programs which use landholder cooperation approaches, there is a need to understand the factors influencing landholder participation in cooperative watershed efforts. A number of basic questions arise: What economic incentives do landholders have to participate? How does this incentive vary with landholding position in the watershed? What social or cultural attributes (including: religious affiliation; age; wealth; land tenure or cooperative tendencies) are correlated with participation or defection? Research into these questions was conducted at the Save the Children Federation (SCF) Watershed Management Project in Maissade, Haiti, as they have utilized a cooperative watershed management approach since 1988. A description of that project and program follow.

COOPERATIVE WATERSHED MANAGEMENT IN MAISSADE: OBJECTIVES, ASSUMPTIONS AND METHODS

Conceptual Framework and History of the Maissade Project

In 1986 SCF, with financing from USAID, initiated a pilot, Integrated Watershed Management project in Maissade, Haiti (a map is included in Appendix 3). Project planners combined two new, yet apparently successful extension approaches: one, the formation of "groupman" [note 1] for peasant mobilization and; two, economic benefit oriented tree planting (embodied in USAID's Agroforestry Outreach Project). The "groupman" were to form the base for Project intervention and be promoted not as ends in themselves, but as the organizational means by which social, economic and ecological problems would be addressed (SCF 1985). Project staff chose to use an agricultural parcel approach to watershed management.

Synopsis of the Physical and Social Setting

The Maissade Commune is located in the Central Plateau region and is generally less degraded and more productive than most other hilly regions of Haiti. The climate is humid sub-tropical with an average annual precipitation of m. Rains are seasonal with a

bi-modal distribution. Spring rains (April to June) are typically more intense than the Fall rains (August to October). Landscapes are dominated by dissected uplands and alluvial plains derived from calcareous sandstones and conglomerates. Soils are predominantly alfisols and vertisols with medium to high levels of nitrogen, medium to low levels of phosphorous, and high levels of potassium. These soils are usually neutral to alkaline and have an organic matter content of about 1% (Tabor 1988).

The Maissade area has been actively cropped for over 100 years. Farmers own an average of three non-contiguous agricultural parcels, and the average parcel size is .7 hectares (Clerisme 1989). Sugar cane was widely cultivated, and the area's most important cash crop, until 5 years ago when local stocks were decimated with an anthracnose fungus. An Organization for American States (OAS) study conducted in 1985 found that approximately 30% of the Maissade area is suited for agriculture yet approximately 70% was intensely cropped. Seventy percent of lands are subject to severe erosion and 45% of all lands slope between 30 and 60%. Five percent of all lands are forested (Erlich 1986).

The vast majority of Commune inhabitants are farmers, and this includes the majority of the 4000 inhabitants of the town of Maissade. A corn-sorghum inter-crop is the predominant cropping system in the area. Field beans are cultivated extensively at higher elevations and yams, plantains, taro, and rice are planted in the more moisture rich sites. Hoes are used for cultivation and few agricultural inputs are used. Population density in 1986 was approximately 100 per kilometers squared (Erlich 1986). A health study conducted in 1989 found an infant mortality rate of 118 per 1000 live births and that acute diarrhea and malnutrition accounted for 42% of infant deaths (Menager and Tamari 1989).

Objectives of the Watershed Management Program

The SCF Project initiated a pilot micro-watershed management program in January of 1989 with the following objectives:

1) encourage the uniform treatment of degraded micro-watersheds (approximately 10 hectares) including the complete treatment of ravines and hillside agricultural parcels;

2) encourage the creation of new social groups composed of individuals who either owned or worked lands within degraded micro-watersheds. These new, permanent institutions would be based on the members' common interest in managing rainfall water to reduce erosion and increase agricultural yields. These groups would construct and maintain soil conservation and agroforestry treatments voluntarily.

SCF aspired to achieve these two objectives in a manner which would promote the spontaneous replication of the technical treatments and cooperative behaviors beyond the direct project impact. In this manner SCF sought to achieve large watershed management "from the bottom up", hoping that the treatment of micro-watersheds would lead to the subsequent treatment of more and larger watersheds. After evaluating the results of the initial "pilot" year, the project intended to expand the program

and continue to support the program for the life of the project (Gaddis and Smucker 1988).

Program Assumptions

In preparing the micro-watershed program, the SCF staff made the following basic assumptions:

1) Soil erosion, which decreases agricultural production unless managed, affects all watershed landholders to varying degrees.

2) In watersheds where farmers rely upon rainfall for agricultural production, and where soil moisture retention is a critical factor for production, the management and lack of management of that rainfall can mean the difference between degraded and productive lands, low or high crop yields, and single or diverse crop farming systems.

3) Simple, low-labor and no financial input, indigenous-based technologies exist which can drastically reduce erosion and the destructive nature of high flows, cause substantial sediment and moisture retention and thereby increase the productivity and diversity of crops both in ravines and on slopes in the short-term.

4) Because of the vulnerability of soil conservation structures to high flows, downstream land owners can not effectively act alone. It is thus in their economic interest to cooperate with upstream owners in treating upstream lands prior to treating downstream lands. This scenario of trans-boundary interdependence between upstream and downstream farmers is especially evident in the case of ravines, and is understood by peasants.

5) Because of the relatively high labor requirements for the construction and maintenance of effective ravine structures, it is in landowners' interest to cooperate on the construction of the structures. Peasants actually perceive the construction of ravine structures as requiring group effort.

6) Previous SCF action to form "groupman" would positively affect the willingness of certain individuals to cooperate on new, complete watershed treatment schemes.

Program Methods

In brief, the method utilized by SCF in 1989 to promote cooperation for micro-watershed management was to:

1) identify eight degraded watersheds averaging 10 hectares where the percentage of landowners who were "groupman" members was relatively high, and some landowners had already constructed soil conservation measures. This initial step was completed in January 1989;

2) conduct on-site meetings with all landowners and land workers in each watershed to discuss local agricultural production trends, the economic effect of the untreated ravine on yields, the potential economic benefit of treatment, the physical, economic and social interdependency of owners, and potential cooperation and coordination for watershed treatment. The purpose of this step was to develop consensual knowledge concerning the common problem and the optimum solution. This step was completed in February 1989;

3) provide non-directive support for the formation of watershed-specific groups whose initial purpose was to construct soil conservation measures, and provide technical assistance to these groups on their chosen work days. This step was conducted from mid February through June of 1989.

The results of the work conducted in year one were reflected in the almost complete treatment of the ravines in two of the eight basins targeted, partial ravine treatment in four, and almost no activity in two. Groups worked almost exclusively in the common ravine and did not work on the private agricultural parcels of the participants. Individuals within the basins did install measures on their agricultural parcels.

In 1990 the project expanded the program to a total of 21 basins and, in order to accelerate the level of peasant effort, made the following significant program changes:

1) increased the presence and influence of project field staff in the planning and execution of cooperative activities;

2) encouraged the establishment of formal micro-watershed committees (representatives of basin farmers chosen by participating farmers) who assumed a directive role in the planning and execution of the work;

3) provided agricultural tools (approximately five per watershed) as an in-kind incentive.

The results of the second year activities are included in the following section on Research Findings; Brief Description of Micro-Watersheds and Activities.

RESEARCH OBJECTIVES AND METHODS

Objectives

The first objective of the research is to investigate and briefly analyze the collective watershed management activity promoted by Save the Children Federation (SCF) in the Maissade area. This investigation would include an analysis of the ravine treatment and the collective work activity by watershed.

The second, and principal objective of the research described in

this paper is to gain a greater understanding of what factors influence participation in the cooperative watershed management activities in the Maissade area. In order to fulfill this objective the following factors will be compared between participant and non-participant populations to determine differences and correlation with participation:

1) Individual exposure to trans-boundary erosion, and potential to directly benefit economically. This factor is indicated by landholding position in the watershed (sideslope, upstream, midstream, downstream) and length of principal ravine on individual's land holding.

2) Relationship between individual effort and realization of direct economic benefit. This factor is indicated by the location and number of checkdams constructed, and whether their location is commensurate with individual participation.

3) Land tenure of agricultural parcel held in the watershed.

4) Individual's religious affiliation. This factor is indicated by two variables: official religious affiliation (Catholic or Protestant) and participation in "voodoo" [note 2] ceremonies.

5) Individual's wealth. This factor is indicated by total number and size of lands held, and the number of cows and pigs owned.

6) Individual's tendency to engage in cooperative activities. This factor is indicated by membership in farmer groups, and the manner in which the individual acquires labor for major agricultural tasks.

7) Individual's tendency to adopt innovations. This factor is indicated by the prior adoption of soil conservation techniques.

8) Age of the individual.

Methods

Various survey instruments (formal and informal, socially and technically oriented) were utilized to acquire substantial information in a short period of time, as well as to permit cross-referencing. These instruments were implemented by the SCF staff of agroforestry technicians, animators (peasant organizers) and the author during August, September and December, 1990. A brief description of each survey follows.

Cooperation in Micro-Watershed Activities

The purpose of this survey was to learn the names of participants and non-participants; the level of participation and treatment in each targeted watershed; peasant perceptions of the role and functions of the group; the relative level of group maturity. This survey was influenced by Dr. E. Ostrom's work on the survival and performance of institutions for collective action (Ostrom 1985) and A. Dani and J. Campbell's proposed methods for evaluating participation (Dani and Campbell 1986). The survey

was also prepared in questionnaire form, part of which could be completed directly by the animators and part of which required open interviews with peasants. One survey form was completed for each targeted watershed. The results of this survey are presented in Table 1.1 of Appendix 1.

Technical Survey of Micro-Watersheds

The purpose of this survey was to learn of land tenure arrangements; property ownership and boundaries, and the position of each soil conservation structure built cooperatively. Surveys were completed by SCF technicians in 21 of the 22 of the watersheds studied. Watershed areas were defined as all lands upstream of the lowest parcel whose owner was invited to the watershed management meetings. Watershed limits and sizes, as well as approximate property boundaries were interpreted from aerial photographs. The photographs used were taken in 1987 by on Organization of American States supported project. The scale of these photos is 1:15000. Some of the basic information resulting from this survey is presented in Table 1.2 of Appendix 1, and a map of a sample watershed is included in Appendix 3.

Open Interviews With Micro-Watershed Committees

This survey was conducted by the author after analyzing the previously mentioned surveys. The purpose of this survey was to gain information on subjects not covered in sufficient depth, and to cross reference information gathered in the animator and technician administered surveys. Additional questions were asked concerning the perceived costs and benefits of cooperation; participant and non-participant histories and socio-economic status, level of consensus within the committee on the nature of the land degradation problem; and the value of alternative solutions and the feasibility of the chosen solution.

In-Depth Survey of Activity in Two Watersheds

Following the completion of the above surveys, three watersheds, representing the extremes in levels of participation, were chosen for in-depth study. In this survey the author held multiple interviews with landholders and various local authorities to gather anecdotal evidence as to the underlying reasons for the abnormal levels of cooperation or defection.

Socio-Economic Profiles of Landholders and Participants

Socio-economic profiles of all individuals who hold land within the sample watersheds and all participants in the management activities were conducted. Survey parameters included: religious affiliation, manner in which the individual acquired labor for major agricultural tasks, total number of land parcels owned, total area of land holdings, number of landholdings in the watershed, land tenure of holdings in the watershed, age, sex, number of cows and pigs owned, whether the individual was a member of "groupman" or not, number of work events assisted, number of checkdams which were constructed on the individuals' land, and whether the individual has adopted contour soil

conservation measures or not. Information concerning wealth (land, pigs, and cows) is difficult to obtain in rural Haiti and was not reported if of questionable reliability. All information was cross-referenced between the local "animate," trusted local informants, and the author. As most rural Haitians do not know their exact age, the ages reported are felt to be reliable within 5 years. Results of this survey are presented in Appendix 2. Tables 2.1, 2.2, and 2.3.

Data Analysis

The Database

Most data collected from the above surveys were compiled in database form. The database included both the names of all individuals who either own land in one of the 22 watersheds or participated in the collective, watershed management activity (n = 268). The landowners were divided into two categories; those who participated (n = 101), and those who did not (n = 85).

Another category of individuals was comprised of participants who did not own land in one of the 22 watersheds (n = 82). In addition to names, 19 other attributes were established to describe the individual and their relationship to the watershed management activity. These attributes were arranged as columns and included:

1) name of watershed where a landholder or active;

2) gender;

3) age;

4) whether the individual is a "groupman" member or not;

5) whether the individual claims a Catholic or Protestant religious affiliation;

6) whether the individual is known to regularly conduct "voodoo" religious ceremonies or not;

7) whether the individual has previously adopted contour soil conservation techniques or not;

8) total number of owned or inherited land parcels;

9) total hectarage of owned or inherited land parcels;

10) number of pigs owned (over the age of 6 months);

11) number of cows owned;

12) number of parcels held in the watershed;

13) type of tenure arrangement to parcels in watershed, whether:
- owned ("te tit, achte, eritye");
- undivided inheritance ("indivize");
- rented ("te fem, pretansyon"); or

- crop-shared ("demwatye");

14) means by which the individual conducts major agricultural tasks ("i.e." labor acquisition), whether the individual works:
- individually ("pou kont yo");
- in pairs ("boukante maten");
- cooperatively, in reciprocal exchange groups ("asosye");
- hires day labor ("bay djob");
- individually and hires day labor;

15) number of collective watershed management work events in which the individual participated;

16) number of ravine checkdams which were constructed on the individual's property;

17) position of the individual's parcel in the watershed, whether:
- sideslope ("i.e." the individual's parcel does not include a portion of the principal ravine);
- upstream ("i.e." head of principal ravine);
- midstream ("i.e." between upstream and downstream parcels);
- downstream ("i.e." the most downstream parcel and the parcels in which the principal ravine was jointly held by two adjoining landholders);

18) length of principal ravine on parcel;

19) whether the ravine is held jointly or held by one individual.

Responses were recorded for each individual in all columns except for: 2 nulls in the tenure arrangement column; 7 nulls in the labor acquisition column; 69 nulls in the total parcels column; 102 nulls in the total hectarage column; 24 nulls in the cows column; and 27 nulls in the pigs column.

Statistical Analysis

As presented in Appendix 2., Tables 2.1, 2.2, and 2.3, all individuals were divided into three categories; watershed landholders who participated, watershed landholders who did not, and participants who did not own land in the watershed where active. Sample means were generated for the attributes recorded as parametric data, and sample proportions were generated for the attributes recorded as categoric data. Statistics from these three populations were compared to determine whether they were the same and from the same population. This information was used to determine which of the attributes surveyed was correlated with participation. The X squared statistic was used to test the categorical data, and the two-tailed Z score used to compare means of the parametric data. Data and results are presented in Appendix 2. Tables 2.1, 2.2, and 2.3.

RESEARCH FINDINGS

Profiles of the Watersheds Studied

As the watersheds studied are randomly located in the southern foothill region the Maissade Commune, they can be considered as random samples of this region of rural Maissade. Information collected concerning watershed inhabitants and land tenure type (represented in the "Combined" category, Appendix 2. Tables 2.1 and 2.3) can thus be considered to approximate the mean conditions for this region of Maissade.

Physical Attributes of the Watersheds

The 22 micro-watersheds studied average 9.0, and range from 2.1 to 34.2 hectares in size. Average hillslope is 12%, and the average length of the principal ravine is 424 meters (see Appendix 1. Table 1.1). The streams are not perennial and only carry storm flow.

Land Tenure and Parcel Position: Types and Frequency

There are an average of 8.9 separate agricultural parcels and 8.5 land holders per watershed. The average reported parcel size is .7 hectares. Of the parcels held in the watersheds: 52% are owned ("achte, eritye, tit"); 33% can be classed as undivided inheritance ("indivize"); 9% are rented ("fem, pretansyon"); and 5% are under crop-share arrangements ("demwatye"). Fourteen percent of landholders work lands in which the principal ravine is jointly owned. In this situation, the centerline of the principal ravine forms the property boundary between adjoining parcels. Of watershed parcels: 27% can be described as having an sideslope position ("i.e." do not contain a major ravine); 16% are upstream (i.e. are located at the head of the ravine system); 37% are midstream ("i.e." located between up- and downstream positions); and 20% are downstream ("i.e." either the most downstream position, or which the ravine is jointly owned). The results described in this Section are presented in Appendix 2. Table 2.1, and Table 2.2 in the "Combined" column.

Socio-economic Profiles of Inhabitants

Of watershed landholders (n = 186): 57% are "groupman" members; 56% have adopted soil conservation techniques; 74% express a Catholic religious affiliation (and the complementary % expressed a Protestant affiliation); and 70% regularly conduct "voodoo" ceremonies. The average age of landholders was 42 years old. Of landholders: 41% claim to conduct major agricultural tasks individually ("pou kont yo"); 13% work in pairs ("boukante maten"); 16% work in cooperative, reciprocal exchange groups ("asosye"); 10% hire day labor ("bay djob"); and 20% equally hire outside labor and work individually (see Appendix 2. Table 2.1).

Landholders own (either in "tit, achte," or "indivize" tenure) an average of 3 separate land parcels, and a total of 2.5 hectares. This finding corroborates that of Clerisme (1989). Landholders also own and average of 1 cow and 1 pig (see Appendix 2. Table

2.3).

Description of the Watershed Management Activities

Ravine Treatment

An average of 27 checkdams were constructed per watershed (with a range of 2 to 92) during the two season's activity. A total of 590 checkdams were constructed in the 22 watersheds. Principal ravines were completely treated [note 3] in 10 watersheds, partial treatment was achieved and 7 and only scant treatment was achieved in 5 watersheds. Checkdams were constructed on the lands of 49% of all landholders. An average of 3 checkdams were constructed per parcel (See Appendix 1. Table 1.2, Appendix 2. Table 2.2, and Appendix 3.).

Cooperation and Participation

Of all landholders, 54% participated, and an average of 4.6 landholders participated per watershed. An average of 3.7 individuals who did not own land in the watersheds participated per watershed. These individuals are referred to as non-watershed participants in the data tables. The number of landholder person/work events averaged 32.2 per watershed, and the number of non-watershed person/work events averaged 18.5. Thus, an average of 57% of all person/work events were contributed by individuals without lands in the watershed. Landholding participants who benefitted from checkdam construction on their land averaged a total of 8 work events at the time of the survey; landholding participants who did not benefit from checkdam construction on their land averaged 6 work events; and non-watershed participants averaged 5 work events (See Appendix 1. Table 1.2). The findings concerning non-watershed participation unsuspected and contradict SCF's goal of achieving watershed management amongst watershed landholders.

The number of work events per watershed per season averaged 9 in 1989 and 6 in 1990. In only 3 of the 22 watersheds did participants claim to have worked cooperatively together prior to

micro-watershed management program initiation. Participants in 13 of the 22 watersheds claimed to have worked cooperatively prior program initiation, but not in the same group. Participants in all of the watersheds claimed to plan to work together to treat other watersheds when the finished with the ravine treatment in the initially targeted watershed. Such a diffusion of behavior has occurred in 4 of the 22 watersheds as these groups have worked a total of 14 work events in watersheds adjoining that initially targeted (See Appendix 1. Table 1.2).

Factors Associated With Participation

The principal objective of the research described in this thesis is to gain a greater understanding of what factors influence

participation in cooperative watershed management activities. In essence, the purpose of the research is to determine which types of individuals participate, which do not, and why. As the role of "non-watershed" participation became apparent it also became imperative to understand who they were and what incentive they had to participate in the watershed treatment. The compiled data and summaries of the statistical analyses of the factors influencing participation are presented in Appendix 2. Tables 2.1, 2.2, and 2.3.

Landholder Exposure to Trans-boundary Erosion, and Potential to Directly Economically Benefit

An "a priori" assumption in this Section is that potential to directly economically benefit is a prime motivation for participation in the collective treatment effort. Similarly, it is assumed that peasants calculate that they reduce their chances to benefit if they do not participate (i.e. the collective watershed treatment group will skip their land, if they do not participate to a degree corresponding to the level of effort needed to treat their land). Another assumption is that landholders directly benefit when checkdams are constructed on their land. This assumption is based on the observation that due to sediment accumulation and subsequent moisture retention, the checkdam creates an enhanced micro-site for crop cultivation. Observation and ongoing research indicate that with checkdam installation, farmers generally shift to the cultivation of more valuable crops, and that productivity on the new micro-site can double previous levels. This hypothesis is reinforced by the widespread adoption of checkdams by farmers in the Maissade area.

The potential for landholders to directly benefit in these manners is indicated by landholding position in the watershed (sideslope, upstream, midstream, downstream) and length of principal ravine on individual's land holding. Following this logic, one would assume that individuals whose lands were in the sideslope position would participate less than those with landholdings in the up-, mid-, and downstream positions. Similarly, one would assume that individuals who own lands in the mid- and downstream position would participate to a greater degree because they have both the most to gain from watershed treatment activity, and the most to lose from inactivity. Also, one would assume that individuals with greater lengths of ravine would participate to a greater degree than those who owned no ravine because they have can benefit the greatest from the cooperative activity.

The following null hypotheses concerning the direct economic incentive to participate were tested and appear in Appendix 2. Table 2.2:

1) The null hypotheses that true proportions of parcel position types for parcels held in the watersheds are the same in the non-participant and participant categories was rejected (X squared = 17.0; $p < 0.001$; $df = 3$).

2) The null hypotheses that the mean length of ravine owned by individuals in the participant and non-participant categories are the same was rejected ($p = 0.029$).

Watershed landholding position and ravine length thus did influence participation. Participants tended to own greater lengths of ravine than non-participants (68 meters versus 55 meters). The majority of participants held either upstream or midstream positions (67%), while the majority of non-participants held sideslope or downstream positions (63%). This influence though is not absolute; 34% of participants held sideslope or downstream positions, while 36% of non-participants held up- or midstream positions. When compared with the "Combined" category (which represents all watershed landholders), participants disproportionately held up- and midstream positions, while non-participants disproportionately held sideslope and downstream positions. These findings counter the hypothesis that individuals with downstream holdings would disproportionately benefit because of their enhanced exposure to risk and potential to benefit.

Relationship Between Individual Effort and Realization of Direct Benefit

Conventional wisdom among watershed management planners in Haiti is that individuals would not voluntarily work on ("i.e." treat) non-participant lands. This assumption is based on the perception that peasants do not perceive that their individual and/or social gain would exceed their individual and/or social cost. This widespread assumption is also influenced by notion that Haitians are very individualistic and have limited social loyalty. This notion belies the finding that "voodoo" encourages

transactional social coherence, and that kin and labor exchange obligations can lead to socially beneficial behavior. As effective watershed management demands that interventions be situated according to physical rather than socio-political factors, an extension of the conventional wisdom would be that all landholders must participate in order to achieve watershed management. It is thus important to test whether the placement of interventions is dependent upon participation or not.

The following null hypotheses concerning the relationship of between participation and direct benefit were tested and appear in Appendix 2. Table 2.2:

1) The null hypotheses that true proportions of landholders who hold parcels on which checkdams were constructed are the same in the non-participant and participant categories was rejected (X squared = 26.8; $p < 0.001$; df = 1).

2) The null hypotheses that the mean number of checkdams constructed on lands held by individuals in the participant and non-participant categories are the same was rejected ($p = 0.001$).

Though a majority of participating landholders benefitted with checkdams constructed on their lands (66% of all landholding participants), checkdams were also constructed on 28% of non-participating landholder lands. Participants thus did disproportionately benefit in relation to non-participants, but only in the gross and not net terms. The 28% of

non-participating landholders who benefitted did so at no cost. Examined economically, the individual net gain of these "free riders" was much higher than that of the participants.

Of a total of 590 checkdams constructed in the watersheds 460 (78%) were constructed on participant land and 130 (22%) were constructed on non-participant land. Non-participants averaged 2 checkdams apiece while participants averaged 4. Thus, though participants did disproportionately benefit, land treatment was not precluded by non-participation. Field observations indicated that on numerous occasions participants would go upstream to treat non-participant lands in order to assure the stability of downstream treatments, and participants would occasionally treat the lands of an absent companion.

As stated in the previous Section, one could assume that an individual would participate to a degree which would correspond to their potential to directly benefit. The following null hypotheses concerning the relationship between level of effort and direct benefit were tested and appear in Appendix 2. Table 2.2:

1) The null hypotheses that the mean number of collective work events worked by landholders who directly benefitted (with checkdams constructed on their land) and those who did not are the same was accepted ($p = 0.157$).

2) The null hypotheses that the mean number of collective work events worked by landholders who directly benefitted (with checkdams constructed on their land) and non-watershed participants are the same was rejected ($p = 0.008$).

3) The null hypotheses that the mean number of collective work events worked by landholders who did not directly benefit (with checkdams constructed on their land) and non-watershed participants are the same was accepted ($p = .386$).

These tests indicate that participation is not strongly correlated with direct economic benefit. The mean number of work events worked by landholders who benefitted, landholders who did not, and non-watershed participants was 8, 6, and 5 respectively.

Because of high levels of variation, there was no significant difference in the amount worked by those who benefitted and those who did not. Again, contrary to conventional wisdom, participation is not based on direct economic gain. It is hypothesized that either the non-benefitting participants benefitted in ways other than that measured. For example, perhaps they owned downstream parcels and were keenly interested in reducing the torrential ravine flow in order to protect their property. Other socio-cultural factors such as kin or labor exchange obligations, may also influence their decision to participate. These will be discussed in following Sections.

The incentive for non-watershed participants to participate, regardless of their inability to directly benefit has not yet been discussed. One of the above tests showed that their level of participation was not significantly different than that of the landholders who benefitted. Incentives for this surprising level of effort might be of a socio-cultural nature and will be

examined in following Sections. This finding of substantial non-watershed participation does indicate that SCF's goal of forming new watershed management groups based on watershed landholding was not achieved as envisioned. In reality, the watershed management groups are a collection of local individuals with various ties to the watershed, either physical, or social.

Land Tenure of Parcel Held in Watershed

Haiti's mixed and largely uncodified land tenure system is claimed by many watershed management professionals in Haiti to be a major constraint to the adoption of soil conservation techniques and overall watershed rehabilitation. Undivided inheritance ("indivize"), rented ("fem") and share-cropped ("demwatye") lands (representing about 47% of all parcels in the watersheds studied) are frequently defined as "insecure" tenures; and thus are not seen as potential sites for soil conservation investment. These conventional opinions are held despite the lack of valid research on the matter.

In the watersheds studied, the center of the ravine defined the property boundary (and thus was jointly owned) in 14% of all parcels. In these cases neither one landowner or the other has either an explicit right or duty to treat the ravine. This complication infers that ravines in this category would be less likely to be treated than ravines that are completely owned by one individual. Consequently, one could hypothesize that landholders of "insecure" parcels and jointly held ravines would participate less than those who hold "secure" tenures and sole rights to the ravine.

The following null hypotheses concerning the relationship between land tenure and participation were tested and appear in Appendix 2. Table 2.2:

1) The null hypotheses that true proportions of tenure status types for parcels held in the watersheds are the same in the non-participant and participant categories was accepted ($X^2 = 5.09$; $p = 0.165$; $df = 3$).

2) The null hypotheses that true proportions of individuals with jointly held ravines are the same in the non-participant and participant categories was rejected ($X^2 = 4.72$; $p = 0.030$; $df = 1$).

The first test indicates that there was no significant difference in land tenure status of agricultural parcels held by participants and non-participants, and thus participation is not dependent upon the land tenure arrangement of lands held in the watersheds. Surprisingly, participant lands are disproportionately "insecure" (54% of their lands) when compared to both the non-participant and combined categories (39% and 47% respectively).

Further examination found that 58% of all checkdams were constructed on owned land ("te tit" or "te achte"), 28% were constructed on undivided inheritance land ("te indivize"), 7% were constructed on rented land ("te fem"), and 9% were constructed on crop-shared land ("demwatye"). As watersheds were

categorically treated from the top-down and the skipping of parcels was rare, and as these percentages reflect closely land tenure patterns in the watersheds (52% owned, 33% inherited, 8% rented and 5% crop-shared), land tenure appears to have had little impact on the placement of ravine treatments in the watersheds. This finding also infers that the "insecure" classification is not useful in determining which landholders might invest in soil conservation. Land "security", and willingness to invest in soil conservation is thus apparently more a product of social linkages than tenure type.

The second test indicates that there is a significant difference in the proportion of landholders who jointly hold ravines between participants and non-participants. Only 9% of participants have joint ravine tenure while 14% of all watershed landholders, and 20% of non-participants have such an arrangement. This finding infers that joint ravine tenure can hinder participation in collective watershed management efforts.

Individual's Religious Affiliation

The possible correlation between religious affiliation and participation was also examined. Though popular opinions on the matter abound, to the author's knowledge, no similar studies have been conducted in Haiti. The following null hypotheses concerning the relationship between religious affiliation and participation were tested and appear in Appendix 2. Table 2.1:

1) The null hypotheses that true proportions of individuals who express a Catholic religious affiliation are the same in the non-participant, participant, and non-watershed categories was rejected (X squared = 10.2; p = 0.006; df = 2).

2) The null hypotheses that true proportions of individuals who regularly conduct "voodoo" ceremonies are the same in the non-participant, participant, and non-watershed categories was rejected (X squared = 11.1; p = 0.004; df = 2).

The first test indicates that participants are disproportionately Protestant to a statistically significant degree. Though 74% of all landholders are Catholic, 65% of participants, 83% of non-participants, and 63% of non-watershed participants expressed a Catholic affiliation. These results might be explained by the hypothesis that in Haiti, where the vast majority of individuals are born Catholic, individuals who are Protestant not only have the gall or drive to reject the "status quo" (or be the offspring of parents who defied the norm), but are also active in pursuing a different tack. This suggests that people of such character might also tend to participate in watershed management activities which are also a rejection to the norm of erosion and declining yields. This rejection of the "status quo", and active participation is reinforced by the Protestant churches, as anecdotal evidence suggests that Protestant institutions in Maissade tend to promote evangelicalism to a greater extent than the Catholic church. Protestant "missions", where groups of the devout march to other areas to preach or raise churches, are frequently seen in the Maissade area.

Though 70% of all landholders regularly conduct "voodoo"

ceremonies, 80% of non-participants, 61% of participants, and 57% of non-watershed participants do the same. The second test indicates that these differences are statistically significant. Regardless of official religious affiliation, a majority of rural Maissadians practice "voodoo." Protestant churches (and many Protestants) publicly claim to reject "voodoo" to a greater extent than the Catholic church. The Catholic church in Haiti is often painted by Protestants as the refuge for "voodoo". Thus, it is hypothesized that fewer Protestants actively practice "voodoo" than do Catholics, and thus fewer participants and non-watershed individuals regularly conduct "voodoo" ceremonies.

Individual's Wealth

It can be hypothesized that with increasing wealth, the relative importance of potential benefits is decreased ("i.e." the marginal value of the benefit decreases), and thus the potential for participation would decline. Similarly, in Haiti, with increasing wealth the tendency for the landowner to actively work their own parcel declines. Generally speaking, the more wealthy the individual, the greater tendency they have to rent out or crop-share their lands. This arrangements would remove the landholder from the agricultural areas and thus decrease their potential for participation. In this study individual wealth is indicated by total number and size of lands held, and the number of cows and pigs owned.

The following null hypotheses concerning the relationship between wealth and participation were tested and appear in Appendix 2. Table 2.3:

1) The null hypotheses that the mean number of land parcels held by landholders in the participant and non-participant categories are the same was accepted (means are equal).

2) The null hypotheses that the mean number of land parcels held by individuals in the participant and non-watershed categories are the same was rejected ($p < 0.001$).

3) The null hypotheses that the mean number of land parcels held by individuals in the non-participant and non-watershed categories are the same was rejected ($p < 0.001$).

4) The null hypotheses that the mean number of hectares held by individuals in the non-participant and participant categories are the same was accepted ($p = 0.523$).

5) The null hypotheses that the mean number of hectares held by individuals in the participant and non-watershed categories are the same was accepted ($p = 0.070$).

6) The null hypotheses that the mean number of hectares held by individuals in the non-participant and non-watershed categories are the same was rejected ($p = 0.026$).

7) The null hypotheses that the mean number of cows owned by individuals in the non-participant and participant categories are the same was rejected ($p < 0.001$).

8) The null hypotheses that the mean number of cows owned by

individuals in the non-participant and non-watershed categories are the same was rejected ($p < 0.001$).

9) The null hypotheses that the mean number of cows owned by individuals in the participant and non-watershed categories are the same was rejected (means are equal).

10) The null hypotheses that the mean number of pigs owned by individuals in the participant, non-participant and non-watershed categories are the same was accepted (all means are equal).

The first three tests indicate that though there is no statistical difference between the mean number of parcels held by participants (3) and non-participants (3); there is a statistical difference between the number owned by landholders and the number owned by non-watershed individuals (2). Similarly, though there is no significant difference in total hectarage owned by participants and non-participants (2.2 and 2.8 respectively); a significant difference does exist between hectarages owned by non-participants and non-watershed individuals (1.6). Because of high variation in the participant population, the difference between hectarages owned by participants and non-watershed individuals was not found to be significant at the $p = .05$ level.

Tests 7., 8. and 9. indicate that non-participants own a significantly greater number of cows than both participants and non-watershed individuals (2, 1, and 1 respectively). Test 10. indicates that all categories own the same mean number of pigs.

In sum, these tests indicate that though the non-participant landholder population may be sometimes be wealthier than landholders who participate (indicated only by the larger number of cows owned), there is a more remarkable difference in wealth status between the non-watershed population and the combined landholder population. Except for the number of pigs owned, non-watershed individuals were categorically less wealthy than the watershed landholders. These results indicate that though wealth status is not strongly correlated with landholder participation, it is inversely correlated with non-watershed participation.

Thus, contrary to what might be expected, wealth does not apparently negatively influence landholder participation. Rather than refuting the general hypothesis that people of wealth would participate less, this finding is probably more an indicator of the scarcity of "wealthy" peasants. Hypotheses concerning why the non-watershed participants tend to be less wealthy will be presented in the following Section.

Individual's Tendency to Cooperate

Some individuals tend to exhibit cooperative tendencies and some do not, and most do sometimes. The various hypotheses as to why or where cooperative tendencies exist would be influenced by socio-cultural patterns, economic incentives and is probably highly dependent upon context, but to delve further into this question is not within the scope of this thesis. It could be

hypothesized that those that exhibited cooperative tendencies prior to the initiation of the micro-watershed program would participate to a greater degree than those that did not.

The following null hypotheses concerning the relationship between individual tendency to cooperate and participation were tested and appear in Appendix 2. Table 2.1:

1) The null hypotheses that true proportions of individuals who are "groupman" members are the same in the non-participant, participant, and non-watershed categories was rejected (X squared

= 75; $p < 0.001$; df = 2).

2) The null hypotheses that true proportions of individuals who acquire labor in similar manners are the same in the non-participant, participant, and non-watershed categories was rejected (X squared = 59.4; $p < 0.001$; df = 8).

Of all watershed landholders, 57% are "groupman" members while 79% of landholder participants, 29% of non-participants and 90% of non-watershed individuals are members. This statistically significant difference, and high correlation of "groupman" membership with participation, is not too surprising as high degree of membership was one criteria for the watershed selection in the micro-watershed management program, and as "groupman" members commonly engage in community development activities. That 90% of the non-watershed participants are members is striking, especially in light of the finding that non-watershed participants contributed 57% of the watershed management effort.

This finding is important as in micro-watershed program implementation SCF made no attempt to rally local "groupman" members to participate or serve as project agents. SCF met with the landholders of targeted watersheds, and it was they themselves (or the "groupman" members themselves) who initiated this non-watershed participation. This phenomenon is probably due to project inculcation that individual gains can be met through collective means, and that all individuals benefit when groups as a whole benefit.

Upon analysis of the other attributes studied, "groupman" membership is the most common denonimator for non-watershed participants. This finding indicates not only that social organization can be strongly correlated with the adoption of collective watershed management activities, but that "groupman" members do act as volunteer agents to promote the activity.

The second test also found a statistically significant difference between how participating and non-participating landholders, and non-watershed participants acquire labor for major agricultural tasks. Approximately 90% of non-participating landholders either work their land individually or hire day labor (or do both), while only 53% of participating landholders and 36% of non-watershed individuals acquire labor in those manners. About 46% of participants exchange labor cooperatively (either in pairs or in groups) while only 10% of non-participants acquire labor in these manners. An even greater percentage of non-watershed participants exchange labor (63%).

These findings confirm the conventional hypothesis that individuals who do not exhibit cooperative tendencies would not tend to participate in cooperative watershed management activities. In addition to the cooperative tendency explanation, the high percentage of non-watershed participants who engage in exchange labor groups indicates that this reciprocal mechanism might be a prime incentive for non-watershed individuals to participate. As social linkages cross physical watershed boundaries, members of labor exchange groups can and probably live and farm in multiple watersheds. If one of the group has agreed to cooperate with neighbors to treat a watershed it is not implausible that the regular exchange partner might participate as well. In this manner the non-watershed participant might build up labor debts for reciprocation. These trans-watershed linkages could also be a mechanism for the diffusion of the complete watershed treatment innovation.

Individual's Tendency to Adopt Innovations

It can be hypothesized that an individual's previous adoption of soil conservation practices would correlate with a potential for participation in cooperative watershed management activities. The following null hypothesis concerning the relationship between individual adoption of soil conservation techniques and participation were tested and appear in Appendix 2. Table 2.1:

1) The null hypotheses that true proportions of individuals who have adopted soil conservation techniques are the same in the non-participant, participant, and non-watershed categories was rejected (X squared = 76.5; $p < 0.001$; $df = 2$).

The proportions of individuals who have adopted techniques in each category correspond almost directly to those of "groupman" membership: 56% of all landholders have adopted, while 28% of non-participants, 79% of participants, and 87% of non-watershed individuals. Participation is thus strongly correlated with technique adoption. This might be due to adopters previous recognition of soil conservation benefits, or perhaps because all adopters are "groupman" members. Whatever the case, this finding is strong evidence that the promotion of individual adoption of soil conservation greatly facilitates the subsequent promotion of collective watershed management activities.

Individual's Age

Individual age was also tested for correlation with participation. One could hypothesize that older people would participate less (either because of infirmity, risk aversion, or wealth) than younger people. The following null hypotheses concerning the relationship between age and participation were tested and appear in Appendix 2. Table 2.1:

1) The null hypotheses that the mean ages of individuals in the non-participant and participant categories are the same was accepted ($p = 0.110$).

2) The null hypotheses that the mean ages of individuals in the non-participant and non-watershed categories are the same was

rejected ($p < 0.001$).

3) The null hypotheses that the mean ages of individuals in the participant and non-watershed categories are the same was rejected ($p = 0.025$).

The mean age of participating landholders, non-participating holders and non-watershed participants was 42, 44, and 35 respectively. The above tests indicate that non-watershed participants were significantly younger than watershed landholders, and that landholder participation was not correlated with age. Other research conducted by the author and the literature on labor exchange indicate that it is young, land-poor males who tend to predominate in labor exchange groups (Murray 1979). The finding that non-watershed participants are significantly younger than landholders corroborates the finding that 63% of this category participate in labor exchange, and that they are generally less wealthy than watershed landholders.

CONCLUSIONS

General Conclusions

Although watershed-based management groups are not always formed, complete watershed ravine treatment is possible.

It is obvious that the second objective of the SCF micro-watershed program -- that of creating watershed management groups based on landholding in a particular watershed -- is not being realized as envisioned. Although 54% of landholders participate, a significant portion of participants (45%) do not own land within the watershed, and these non-watershed participants contributed 57% of all labor to the management activities. In addition, all of the groups intend to treat other neighboring basins following the treatment of the targeted basin. One of the most advanced groups ("Met Pye") actually spent the majority of the second season working outside of the targeted watershed rather than within it. This "mixed" nature of the groups does not preclude complete ravine treatment as the principal ravine has been completely treated in 10 of the 22 watersheds.

In sum, the SCF strategy can result in complete ravine treatment but the work will probably not be executed by a social unit which is specific and limited to an individual watershed. The existence of this trans-watershed cooperation indicates that there is likely to be more than one solution to the problem of peasant coordination for contiguous land treatment. Different social conditions would plausibly give rise to different social reactions and formations. And thus different project strategies would be appropriate for different social conditions.

Participants will voluntarily treat non-participant land.

Participants in the cooperative activity have on numerous occasions worked voluntarily on non-participant land (even without permission and no hope for reciprocal assistance). Twenty eight percent of all check-dams were constructed on non-participant land, and check-dams were built on only 64% of all landholders' land. The motivations for this behavior were not thoroughly researched. Anecdotally it is known that on occasions non-participant land was treated when the participants felt that treatment of that land was necessary to assure the success of downstream work. On other occasions participants treated the land of non-participant kin or companions for apparent socio-cultural reasons unknown to the author.

"Groupman" and labor exchange groups appear to be the primary facilitators of both the adoption and the diffusion of the cooperative watershed management innovation.

The vast majority of landholder and non-watershed participants are "groupman" members and also members of labor exchange groups.

The incentives and obligations corresponding to participation in these institutions apparently set a foundation for cooperation on treating trans-boundary problems. The "regional" rather than watershed specific dispersion of kin, labor partners and agricultural parcels can lead to the diffusion of the cooperative watershed management innovation. These findings indicate that the strength of indigenous social institutions ("e.g." "asosye" and "boukante maten") override the physical linkages determined by contiguous ownership in small watersheds. These findings also offer strong evidence that development agency investment in peasant organization can greatly facilitate the achievement of watershed rehabilitation, and the treatment of collective environmental problems.

Factors Associated With Participation in Cooperative Watershed Management

Landholder Exposure to Trans-boundary Erosion, and Potential to Economically Benefit

Watershed parcel position, and length of ravine owned (two indicators of landholder exposure to trans-boundary erosion and the potential to economically benefit) did influence participation. The majority of participants held either upstream or midstream positions, while the majority of non-participants held either sideslope or downstream positions. This finding refutes the hypothesis that the holder of the most downstream position had the greatest incentive to participate and was thus the most likely to participate. Up- and midstream positions are normally more optimum sites for checkdam construction, and thus the potential for the holder to economically benefit exists. Sideslope positions are by definition, inappropriate sites for construction. Though theoretically, the holder of downstream parcels might be the most likely to participate, in the watersheds studied, this incentive was apparently complicated by the fact that in many downstream parcels the ravine was jointly held by adjacent landholders. This disincentive will be discussed in the following conclusion on the impact of land

tenure on participation.

These findings infer that projects which consider a landholder cooperation approach to watershed management should concentrate effort on the up- and mid-stream holders; those with the clearest potential economic incentive to participate.

Relationship Between Individual Effort and Realization of Direct Benefit

The realization of a direct benefit (as indicated by checkdam construction) was not correlated with participation. Though more checkdams were constructed on participating landholder lands than non-participating landholder lands, participation was not strongly correlated with the individual's benefit of checkdams. As stated in General Conclusions number 2., participants regularly treated non-participant lands. The level of individual effort (i.e. number of work events worked) was not significantly different between those who directly benefitted from checkdams and those who did not during this period of study. In addition, non-watershed landholders contributed 57% of all effort with no direct benefit as measured by this study. Thus individual effort "(i.e." cost) is not commensurate with individual gain during the period of the study, again, at least as individual gain is measured by this study.

When considered in light of the previous conclusion, these findings indicate that the actual realization of checkdams (or of another unmeasured benefit) during the same year as labor is expended is not a precondition for participation. The first conclusion indicated that landholders who participate tend to have the clearest potential for economic gain. Landholders who participate and who did not benefit a checkdam during the period studied, might participate now to assure a delayed benefit, when the watershed groups treats their land next year. The motivation for non-watershed landholders to participate might be similar (i.e. anticipation of future checkdam construction on their land). The incentive for the non-beneficiaries to participate could also very likely be other, unmeasured benefits such as labor reciprocity, or kin obligations.

Land Tenure of Parcel Held in Watershed

Land tenure status of parcels held in the watershed did not influence landholder participation. No significant difference exists in the frequency of land tenure types between participants and non-participants. Contrary to conventional belief, the holding of short-term and undivided land tenure arrangements ("fem, pretansyon, demwatye, indivize")did not negatively affect the participation of the holders and the placement of soil conservation measures. The holders of these un-codified tenures are regular participants and same-season economic gains derived from the treatments seem to be the incentive for short-term holders to participate and adopt soil conservation treatments. This finding infers that strong or strengthened social linkages can overcome the commonly perceived problem of "insecure" short-term and undivided land tenure arrangements. Further, social ties and not the term of tenure apparently determines land "insecurity".

Though tenure over parcels held in the watersheds was not correlated with participation and the placement of treatments, the tenure of the ravine was important. Individual's who jointly hold rights to principal ravines (a common characteristic of parcels in the downstream position where the ravine forms a common property boundary) tended to participate less than those who have clear rights to the entire ravine. This finding suggests that promoters of cooperative watershed management should encourage cooperation amongst landholders upstream of where the ravine is jointly held ("i.e." forms a property boundary).

Individual's Religious Affiliation

An individual's religious affiliation does influence participation. Participants are disproportionately Protestant and are less likely to regularly conduct voodoo ceremonies than non-participants. This finding might be a reflection of what types of people choose to be Protestant, or a reflection of the institutional messages passed by Protestant churches. As this topic is politically volatile and beyond the expertise of the author, no specific interpretations or recommendations will be made. This finding does at least indicate that watershed planners should not preclude channeling watershed management messages through religious institutions.

Individual's Wealth

Landholder's wealth (as indicated by the number and size of landholdings, cows and pigs) apparently does not influence participation. A difference in landholder wealth is not significant between participating and non-participating landholders. In comparison, landholders are significantly more wealthy than non-watershed participants. This finding infers also that there is no significant wealth differences between individuals in the watersheds studied. The finding that the non-watershed participants are less wealthy corresponds to the finding that they tend to be younger and work in labor exchange groups (see following Sections). Their incentive to participate can only be postulated; perhaps they are returning kin obligations, perhaps they are building up labor debts so as to assure access to adequate labor demanded.

Individual's Tendency to Cooperate

An individual' tendency to cooperate, as indicated by "groupman" membership and cooperative labor acquisition tendencies, is strongly correlated with participation. This conclusion is drawn from the finding that 29% of non-participating landowners are "groupman" members, 79% of participants are members and 90% of non-watershed participants are members. "Groupman" membership is also the most common attribute of non-watershed participants. This finding indicates that the individual satisfaction derived from the promotion of social benefit, or the fulfillment of a social duty might be the strongest incentive for non-watershed individuals to participate.

The manner in which individuals acquire labor for major agricultural tasks also influences participation. A majority of participants engage in cooperative labor exchange arrangements ("boukante maten, asosye") while a majority of non-participants either work their land as individuals or hire day labor ("pou kont yo, bay djob"). These findings infer that projects which seek to promote cooperative watershed management should consider investing in the formation of peasant organizations, and/or channel extension efforts through existing labor exchange groups.

Individual's Tendency to Adopt Innovations

An individual's tendency to adopt soil conservation innovations is strongly correlated with participation. While only 28% of non-participants have adopted soil conservation techniques, 79% of participants and 87% of non-watershed participants have adopted soil conservation techniques. This finding indicates that either adopters participate because they recognize the economic benefits of soil conservation, or because they just happen to be the type of people who adopt innovations. Whatever the case, this finding is strong evidence that the promotion of soil conservation techniques to individuals facilitates the subsequent adoption of cooperative watershed management.

Individual's Age

An individual's age does not influence landholder participation, but younger ages are correlated with non-watershed participation.

The non-watershed participant's disproportionate youth corroborates findings that they tend to be less wealthy and exchange rather than hire labor. This finding infers that except if seeking to encourage non-watershed participation, watershed programs should not consider age as an important factor in cooperative watershed management.

APPENDIX 1: DESCRIPTION OF WATERSHEDS AND MANAGEMENT ACTIVITY

Table 1.1, Description of Participation and Effort in Watersheds Studied

Parameters	Watersheds					
	1	2	3	4	5	6
Initial year of activity.	89	89	89	89	89	89
No. landholder participants.	4	5	4	7	2	8
No. non-wsd participants.	1	5	3	8	3	1
No. landholder person/work events.	45	37	9	21	16	242
No. non-wsd person/work events.	14	8	8	18	10	33
No. work events in wsd ravine.	0/14	5/5	4/0	2/2	4/7	28/5
No. work events outside wsd.	0/0	0/0	0/0	0/0	0/0	0/0

Do wsd groups plan to work in other wsds (1=yes; 0=no)?	1	1	1	1	1	1
Did participants work collectively in the same group prior to program?	0	0	0	0	0	0
Did participants work collectively in various groups prior to program?	0	1	1	1	0	1
No. checkdams in wsd.	9	26	9	35	19	85

Parameters	Watersheds					
	7	8	9	10	11	12
Initial year of activity.	89	90	90	90	90	90
No. landholder participants.	6	3	6	2	3	2
No. non-wsd participants.	10	2	6	4	3	5
No. landholder person/work events.	62	8	35	24	26	3
No. non-wsd person/work events.	135	6	14	33	31	11
No. work events in wsd ravine.	11/4	3	13	10	11	3
No. work events outside wsd.	0/7	0	0	4	2	0
Do wsd groups plan to work in other wsds (1=yes; 0=no)?	1	1	1	1	1	1
Did participants work collectively in the same group prior to program?	1	0	0	0	1	0
Did participants work collectively in various groups prior to program?	0	0	1	1	1	0
No. checkdams in wsd.	92	2	34	13	12	16

Parameters	Watersheds					
	13	14	15	16	17	18
Initial year of activity.	90	90	90	90	90	90
No. landholder participants.	4	8	4	4	1	7
No. non-wsd participants.	6	3	12	2	5	0
No. landholder person/work events.	8	38	11	12	5	38
No. non-wsd person/work events.	9	17	26	5	16	0
No. work events in wsd ravine.	3	10	4	3	5	8
No. work events outside wsd.	0	0	0	0	0	0
Do wsd groups plan to work in other wsds (1=yes; 0=no)?	1	1	1	1	1	1
Did participants work collectively in the same group prior to program?	0	0	0	0	1	0
Did participants work collectively in various groups prior to program?	1	1	1	1	0	1
No. checkdams in wsd.	36	54	20	12	9	16

Parameters	Watersheds					
	19	20	21	22	Mean	S.D
Initial year of activity.	90	90	90	90	/	/
No. landholder participants.	9	3	4	5	4.6	2.2
No. non-wsd participants.	0	3	0	0	3.7	3.2
No. landholder person/work events.	25	12	12	19	/	/
No. non-wsd person/work events.	0	13	0	0	/	/
No. work events in wsd ravine.	8	4	0	6	9/6	10/4
No. work events outside wsd.	0	1	0	0	.6	1.7
Do wsd groups plan to work in other wsds (1=yes; 0=no)?	1	1	1	1	1	0
Did participants work collectively in the same group prior to program?	0	0	0	0	.1	.4
Did participants work collectively in various groups program?	1	0	0	0	.6	.5
No. checkdams in wsd.	35	20	16	20	26.8	23.3

Notes:

1). Figures presented in this table are the results of a survey conducted in August and September, 1990.

2). Watershed code. 1) Do Pye Moris (1); 2) Do Bwa Pen; 3) Savan a Palm; 4) Zeb Razwa; 5) Paloat; 6) Nan Manwel; 7) Met Pye; 8) Dlo Kontre; 9) Larik; 10) Do Pye Moris (2); 11) La Guam; 12) Vikam; 13) Zeb Gine; 14) Savan a Palm (Talma); 15) Tidjo; 16) Perikit; 17) Fond Pikan; 18) Nan Silinn (LSY); 19) Basya; 20) Ba Simitye; 21) Nan Silinn (MJ); 22) Nan Nikola.

3. The first and second numbers in the work events columns indicate events in 1989 and 1990 respectively.

Table 1.2, Physical and Socio-economic Characteristics of Watersheds Studied

Parameters	Watersheds					
	1	2	3	4	5	6
Wsd area (has).	4.8	3.6	11.3	3.7	9.1	20.1
No. land parcels.	6	5	12	14	8	14
No. land holders.	6	5	11	13	8	14
Mean parcel size (has).	1.0	0.6	0.4	0.5	0.3	1.0
No. parcels with long-term tenure arrangements.	6	4	10	9	7	13
No. parcels with short-term tenure arrangements.	0	1	2	5	1	1
Mean slope of parcels (%).	10	5	15	6	30	34
Length of principal ravine (m).	237	413	455	497	432	1061

Parameters	Watersheds					
	7	8	9	10	11	12
Wsd area (has).	8.4	4.0	22.8	8.1	/	5.3
No. land parcels	15	5	8	5	4	4
No. land holders.	14	5	7	5	4	4
Mean parcel size (has).	.5	.8	.6	/	/	.4
No. parcels with long-term tenure arrangements.	12	4	8	5	4	3
No. parcels with short-term tenure arrangements.	3	1	0	0	0	1
Mean slope of parcels (%).	8	6	7	/	/	6
Length of principal ravine (m).	417	254	465	/	/	282

Parameters	Watersheds					
	13	14	15	16	17	18
Wsd area (has).	5.7	34.2	6.0	2.1	4.0	3.6
No. land parcels	10	20	6	5	5	7
No. land holders.	9	20	4	5	5	7
Mean parcel size (has).	.3	1.6	.5	/	/	1.0
No. parcels with long-term tenure arrangements.	10	19	2	3	5	7
No. parcels with short-term tenure arrangements.	0	1	4	2	0	0
Mean slope of parcels (%).	4	4	7	/	/	17
Length of principal ravine (m).	337	/	198	190	/	659

Parameters	Watersheds					
	19	20	21	22	Mean	S.D
Wsd area (has).	19.1	3.1	5.3	3.7	9.0	8.3
No. land parcels	17	4	14	7	8.9	4.8
No. land holders.	16	4	13	7	8.5	4.6
Mean parcel size (has).	1.0	/	.9	/	0.72	0.35
No. parcels with long-term tenure arrangements.	14	3	13	6	7.6	4.4
No. parcels with short-term tenure arrangements.	3	1	2	1	1.3	1.4
Mean slope of parcels (%).	34	/	6	/	12.4	10.7
Length of principal ravine (m).	717	274	313	/	424	222

Notes:

1) Figures presented in this table are the results of a survey conducted in August and September, 1990.

2) Watershed code. 1) Do Pye Moris (1); 2) Do Bwa Pen; 3) Savan a Palm; 4) Zeb Razwa; 5) Paloat; 6) Nan Manwel; 7) Met Pye; 8) Dlo Kontre; 9) Larik; 10) Do Pye Moris (2); 11) La Guam; 12) Vikam; 13) Zeb Gine; 14) Savan a Palm (Talma); 15) Tidjo; 16) Perikit; 17) Fond Pikan; 18) Nan Silinn (LSY); 19) Basya; 20) Ba Simitye; 21) Nan Silinn (MJ); 22) Nan Nikola.

3) Mean parcel size was converted from fractions of "carreaux" (1 "carreau" = 1.29 hectares) as reported by landholders. As landholders do not know the precise size of their holdings, these means are approximations.

4) Long-term tenure arrangements include purchased ("te achte, te tit"), divided ("te erite"), and undivided inheritance lands ("te indivize").

5) Short-term tenure arrangements include rented ("te fem, pretansyon", and crop-shared ("demwatye").

APPENDIX 2: FACTORS ASSOCIATED WITH PARTICIPATION

Table 2.1, Social Profiles of Participants and Non-participants

Variable	Watershed Landholder Category		Non-wsd Participants
	Non-Participants	Combined Part.	
No. of individuals in each category.	85	101	186	82
% who are "groupman" members.	29	79	57	90
% who have adopted soil conservation techniques.	28	79	56	87
% who are female.	6	5	5	10
% who are Catholic (complementary % expressed a Protestant affiliation).	83	65	74	63
% who regularly conduct "voodoo" ceremonies.				

	80	61	70	57
Manner in which individuals conduct major agricultural tasks (labor acquisition):				
% who work individually ("pou kont yo"):	48	34	41	21
% who work in pairs ("boukante maten"):	6	20	13	16
% who work cooperatively ("asosye"):	5	26	16	47
% who hire day labor ("bay djob"):	14	6	10	2
% who work individually and hire day labor:	27	13	20	13
Mean age (standard deviation in parentheses).	44(14)	41(11)	42(13)	35(11)

Notes:

1) Figures presented in this table are the results of a survey of all watershed landholders and all management activity participants in the 22 watersheds. Data was collected in December, 1990.

2) Statistical analysis: The X squared statistic was used to compare variable proportions between categories and types for the categorical data (expressed in this table as %).

Test 1 The null hypotheses that true proportions of individuals who are "groupman" members are the same in the non-participant, participant and non-watershed categories was rejected (X squared = 75.; p = 0.000; df = 2).

Test 2 The null hypotheses that true proportions of individuals who have adopted soil conservation techniques are the same in all categories was rejected (X squared = 76.5; p = 0.000; df = 2).

Test 3 The null hypotheses that true proportions of individuals who express a Catholic religious affiliation are the same in all categories was rejected (X squared = 10.2; p = 0.006; df = 2).

Test 4 The null hypotheses that true proportions of individuals who regularly conduct "voodoo" ceremonies are the same in all categories was rejected (X squared = 11.1; p = 0.004; df = 2).

Test 5 The null hypotheses that true proportions of individuals who acquire labor in similar manners are the same in all categories was rejected (X squared = 59.4; p = 0.000; df = 8).

3) Statistical analysis: A two-tailed Z-test was used to test hypotheses that mean ages are the same between categories of individuals.

Test 1 The null hypotheses that the mean age of individuals in the non-participant and participant categories are the same was accepted (p = 0.110).

Test 2 The null hypotheses that the mean age of individuals in the non-participant and non-watershed categories are the same was rejected (p = 0.000).

Test 3 The null hypotheses that the mean age of individuals in

the participant and non-watershed categories are the same was rejected (p = 0.025).

Table 2.2, Indicators of Direct Economic Incentive to Participate

Variable	Watershed Landholder Category		
	Non-participant	Participant	Combined
No. of individuals in each category.	85	101	186
% of holders who benefited checkdams.	28	66	49
Mean no. of checkdams constructed per parcel.	2(3)	4(5)	3(4)
Tenure status of parcels held in watershed:			
% owned ("tit" or "achte"):	58	47	52
% undivided inheritance ("indivize"):	28	38	33
% rented ("fem" or "pretansyon"):	9	8	9
% crop-shared ("demwatye"):	2	8	5
Position of parcel in watershed:			
% sideslope (i.e. no ravine on parcel):	36	20	27
% upstream (i.e. top of ravine):	13	19	16
% midstream (i.e. mid-ravine):	23	48	37
% downstream (i.e. bottom of ravine):	27	14	20
Mean length of ravine owned:	55(37)	68(44)	62(45)
% of individuals with joint ownership of ravine:	20	9	14
Mean no. of work events in which individuals participated: those who benefited checkdams:	/	8(8)	/
those who did not:	/	6(6)	/

Variable	Non-wsd Participants
No. of individuals in each category.	82
% of holders who benefited checkdams.	0
Mean no. of checkdams constructed per parcel.	0
Tenure status of parcels held in watershed:	
% owned ("tit" or "achte"):	/
% undivided inheritance ("indivize"):	/
% rented ("fem" or "pretansyon"):	/
% crop-shared ("demwatye"):	/
Position of parcel in watershed:	
% sideslope (i.e. no ravine on parcel):	/
% upstream (i.e. top of ravine):	/

% midstream (i.e. mid-ravine): /

% downstream (i.e. bottom of ravine): /

Mean length of ravine owned: /

% of individuals with joint ownership of ravine: /

Mean no. of work events in which individuals participated: those who benefited checkdams: /

those who did not: 5(5)

Notes:

1) Figures presented in this table are the results of a survey of all watershed landholders and all management activity participants in the 22 watersheds. Data was collected in December, 1990.

2) Statistical analysis: The X squared statistic was used to compare proportions between categories and types indicated with categorical data (expressed here as %).

Test 1 The null hypotheses that true proportions of landholders who benefited checkdams are the same for non-participant and participant landholders was rejected (X squared = 26.8; p = 0.000; df = 1).

Test 2 The null hypotheses that true proportions of tenure status types are the same for non-participant and participant landholders was accepted (X squared = 5.09; p = 0.165; df = 3).

Test 3 The null hypotheses that true proportions of parcel position types are the same for both categories for non-participant and participant landholders was rejected (X squared = 17.0; p = 0.001; df = 3).

Test 4 The null hypotheses that true proportions of individuals with jointly held ravine parcels are the same for both non-participant and participant landholders was rejected (X squared = 4.72; p = 0.030; df = 1).

3) Statistical analysis: A two-tailed Z-test was used to test the hypotheses that variable means are the same for the all categories of individuals.

Test 1 The null hypotheses that the mean number of checkdams constructed on participant and non-participant lands are the same was rejected (p = 0.001).

Test 2 The null hypotheses that the mean length of ravine owned by participants and non-participants is the same was rejected (p = 0.029).

Test 3 The null hypotheses that the mean number of work events worked by participants who directly benefitted and those who did not was accepted (p = 0.157).

Test 4 The null hypotheses that the mean number of work events

worked by participants who did not directly benefit and non-wsd participants was accepted (p = 0.386).

Test 5 The null hypotheses that the mean number of work events worked by participants who directly benefited and non-wsd participants was rejected (p = 0.008).

Table 2.3, Indicators of Wealth Status of Participants and Non-participants

Variable	Watershed Landholder Category		
	Non-participant	Participant	Combined
No. of individuals in each category.	85	101	186
Mean no. of parcels held ("tit" or "indivize").	3(1)	3(2)	3(2)
Mean no. of hectares held ("tit" or "indivize").	2.2(2.1)	2.8(6.5)	2.5(5.0)
Mean no. of cows owned.	2(2)	1(2)	1(2)
Mean no. of pigs owned.	1(1)	1(1)	1(1)

Variable	Non-wsd Participants
No. of individuals in each category.	82
Mean no. of parcels held ("tit" or "indivize").	2(1)
Mean no. of hectares held ("tit" or "indivize").	1.6(1.3)
Mean no. of cows owned.	1.1
Mean no. of pigs owned.	1(1)

Notes:

1) Figures presented in this table are the results of a survey of all watershed landholders and all management activity participants in the 22 watersheds studied. Data was collected in December, 1990.

2) Statistical analysis: A two-tailed Z-test was used to test the hypotheses that variable means are the same for the all categories of individuals.

Test 1 The null hypotheses that the mean number of parcels held by individuals in the participant and non-wsd categories are the same was rejected (p = 0.000).

Test 2 The null hypotheses that the mean number of parcels held by individuals in the non-participant and non-wsd categories are the same was rejected (p = 0.000).

Test 3 The null hypotheses that the mean number of hectares held by individuals in the participant and non-participant categories are the same was accepted (p = 0.523).

Test 4 The null hypotheses that the mean number of hectares held

by individuals in the participant and non-wsd categories are the same was accepted (p = 0.070).

Test 5 The H O that the mean number of hectares held by individuals in the non-participant and non-wsd categories are the same was rejected (p = 0.026).

Test 6 The null hypotheses that the mean number of cows owned by individuals in the participant and non-participant categories are the same was rejected (p = 0.000).

Test 7 The null hypotheses that the mean number of cows owned by individuals in the non-participant and non-wsd categories are the same was rejected (p = 0.000).

APPENDIX 3: MAPS OF THE WATERSHEDS STUDIED

Map 1, The Maissade Area Watersheds

Map 2, Example Watershed: One of the 22 Studied

NOTES

1. "Groupman" are pre-cooperative peasant groupings established upon traditional social linkages. The groups commonly engage in collective social and economic activities and average eight members.

2. It is assumed that the vast majority of Haitians believe in some aspects of the "voodoo" folk religion. The people of Maissade distinguish between those who regularly "sevi loua" by donating "plat manje" to ancestral spirits, and those who have ceased to continue this practice. It was this distinction that was used to categorize the individuals surveyed.

3. The "completely treated" watershed category includes those in which the principal ravine is treated from the uppermost parcel to the most downstream parcel. The "partial" category includes those in which more than one checkdam has been constructed on more than one parcel. The "scant" category includes those watersheds in which less than 10 treatments have been installed on one or fewer parcels.

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